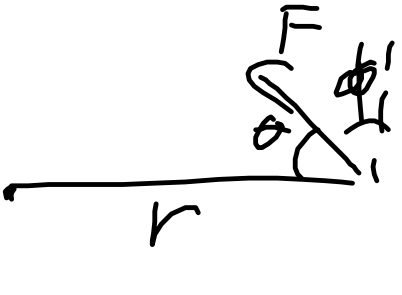
Statics

Torque: $\tau = F r \sin\theta$



Rotational Equilibrium: no rotational acceleration

$\Sigma \tau_C = \Sigma \tau_{CC}$ or $\Sigma \tau = 0$

Translational equilibrium: No acceleration of CM,

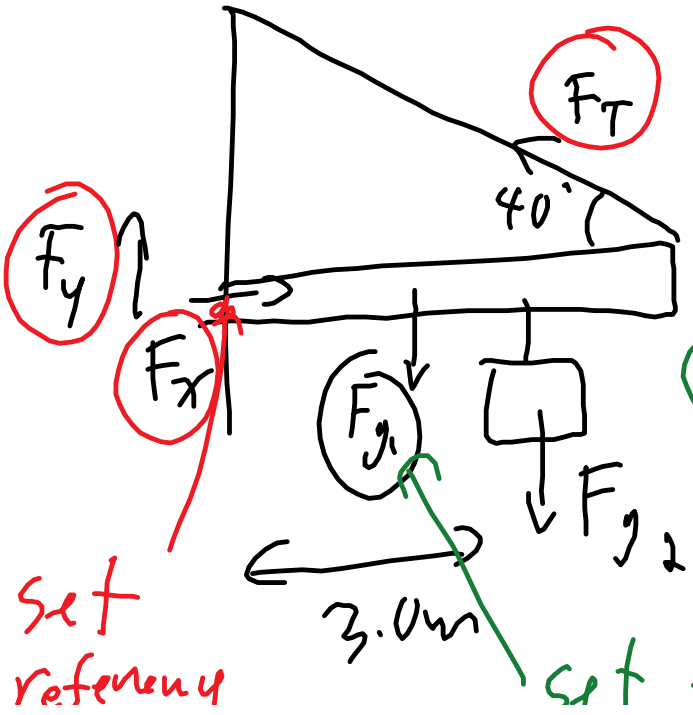
$\Sigma F = 0$ $\Sigma F_{up} = \Sigma F_{down}$ and $\Sigma F_{right} = \Sigma F_{left}$

Static Equilibrium:

Both rotational and Translational equilibrium

eg. A 5.0 kg 4.0m long beam is holding a 10.0 kg sign 3.0m down the length from a wall. A cable supports the beam from the end making a 40.0° angle to the beam.

1. what is the tension in the supporting cable?
2. what are the x and y components of the force of the wall on the beam?



$\Sigma \tau_C = \Sigma \tau_{CC}$

$F_{g_2} r_2 + F_{g_1} r_1 = F_T L \sin\theta$

reference point where 2 unknowns will

set the weight of the beam at the centre of mass

$10Kg \times \frac{9.8N}{1kg} \times 3m + 5kg \times \frac{9.8N}{kg} \times 2m = F_t 4m \sin(40)$

10x9.8x3=294
5x9.8x2=98
4xSin(40)=2.571150438746157

(294+98)/2.57115=152.46096

$F_t = 1.5 \times 10^2 N$

2. only x forces are $F_t\cos\theta$ and F_x, the compression force off the wall.
   F_x= 152.46096xCos(40)=
   116.7918712005848
   $F_x = 1.2 \times 10^2 N$ right

   $\sum F_{yup} = \sum F_{ydown}$
   $F_y + F_t\sin\theta = F_{g1} + F_{g2}$
   F_y = ((10x9.8)+(5x9.8))-

(152.46096xSin(40))=48.99998395108493
F_y =48N up

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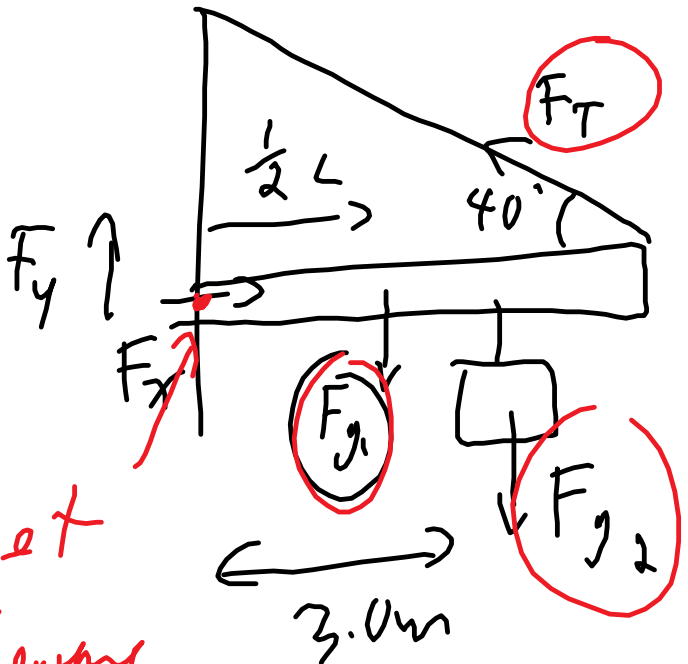


$\uparrow = F_T \sin\theta$

$\Sigma T_c = \Sigma T_{ccw}$

$F_{g_2} r_2 + F_{g_1} r_1 = F_T L \sin\theta$

Set reference point - multiple unknowns

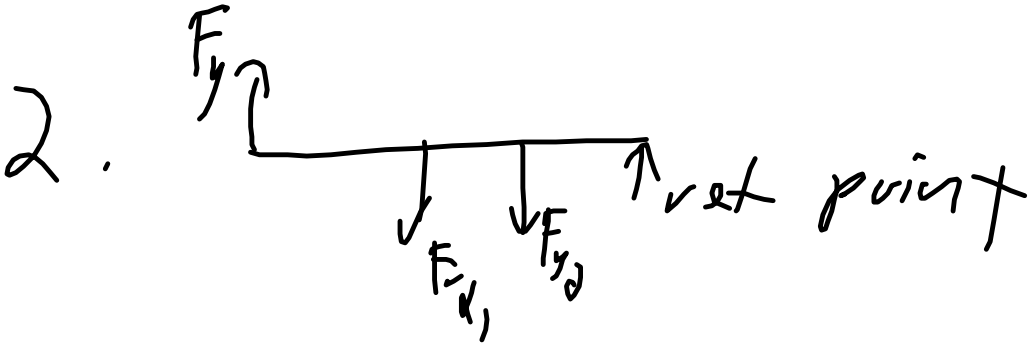
centre of the Beam

- multiple unknowns

$10kg \times 9.8\frac{N}{kg} \times 3m + 5kg\left(9.8\frac{N}{kg}\right)(2.4m) = F_t \times 4m \sin 60°$

$F_t = 152.46N \approx 1.5 \times 10^2 N$

2.



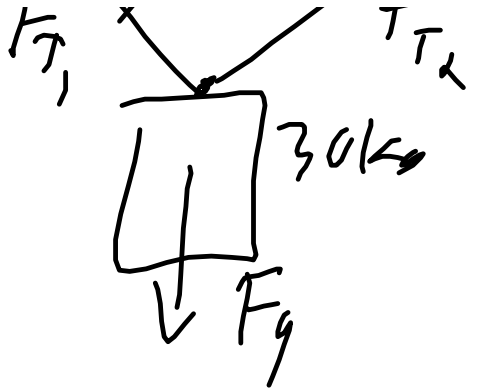
$F_y 4m = 5kg \times 9.8\frac{N}{kg} \times 2m + 10kg\left(9.8\frac{N}{kg}\right)(10m)$

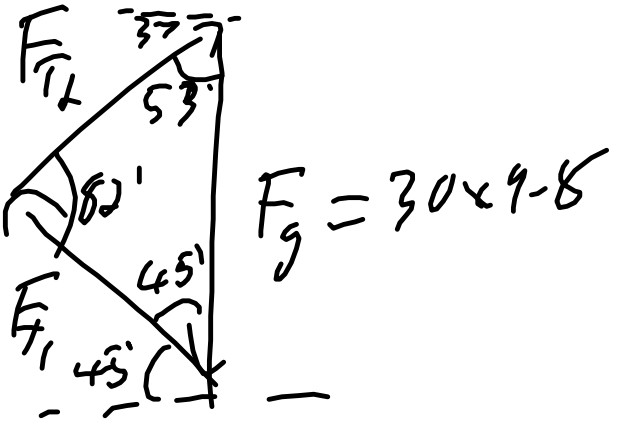
$F_y = 49N$

$F_x = F_t \cos 60°$

$= 116N = 1.2 \times 10^2 N$

Q7 p230

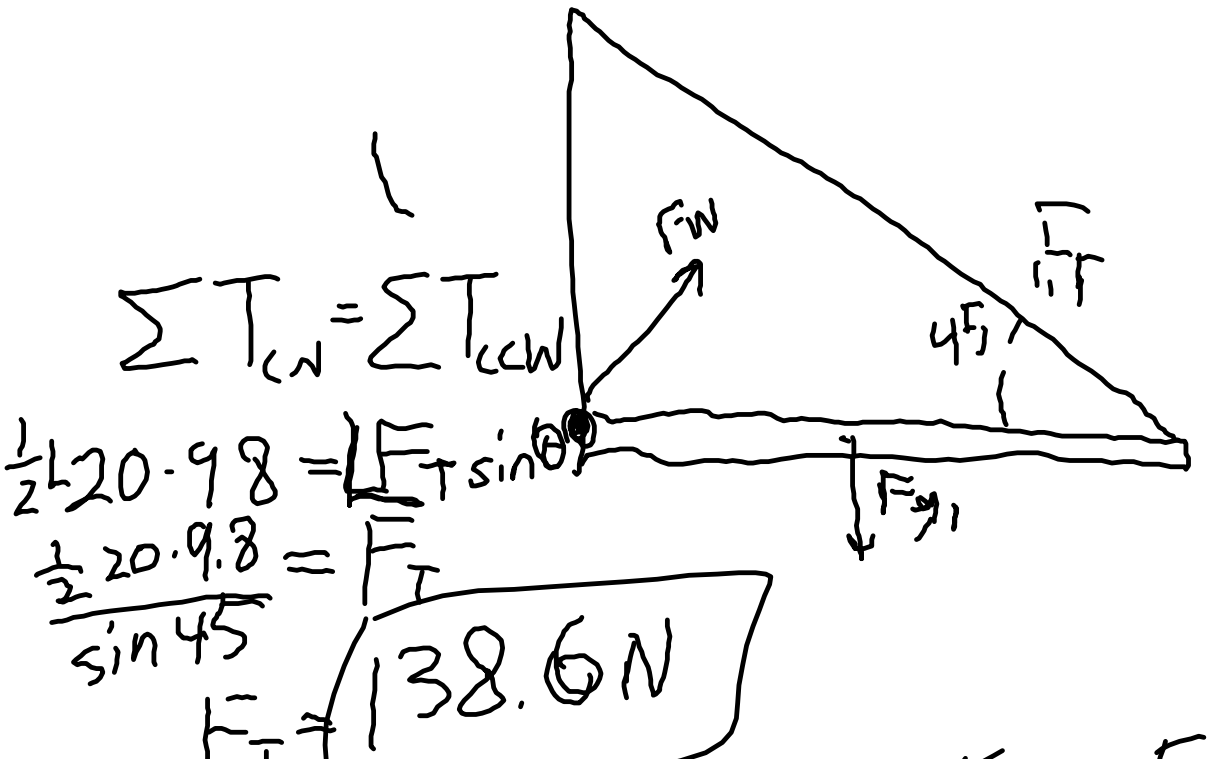




$$\frac{\sin 45^\circ}{F_{T_2}} = \frac{\sin 53}{F_{T_1}} = \frac{\sin 82}{30 \times 9.8}$$

p231
Q 15, 17, 18, 21, 61 bring your labbook

20 minutes, call on students to come up and do Q15, 18, 21



$F_T = 158.01 N$

$F_x = F_T \cos 65°$

$F_W = \sqrt{F_x^2 + F_y^2}$

$F_y = 98 N$

$F_y + F_T \sin\theta = mg$

$F_y = mg - F_T \sin\theta$

$= 98 N$

$F_W = \sqrt{96^2 + 98^2} = 138.6 N$

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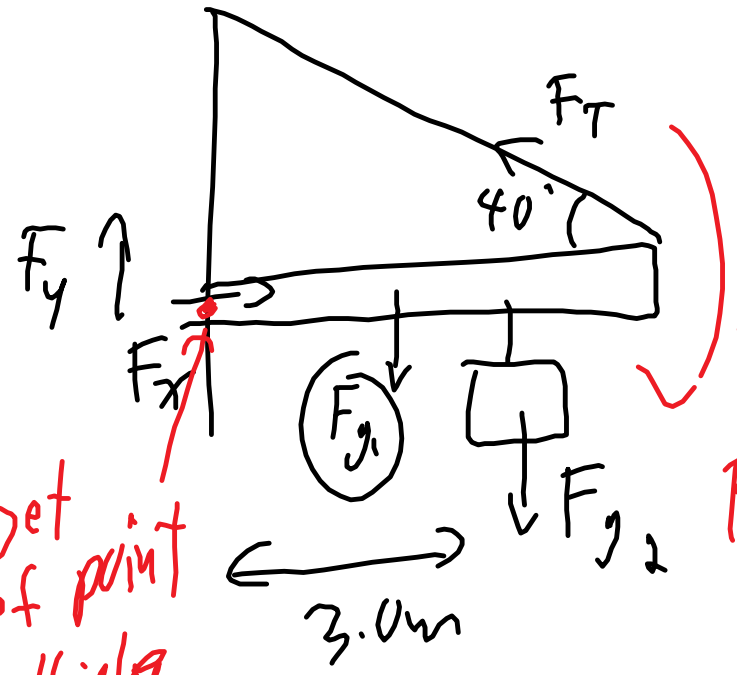


$\Sigma\tau_{cc} = \Sigma\tau_{cc}$

clockwise

set ref point

multiple unknowns

$F_{g_2} r_2 + F_{g_1} r_1 = F_T L \sin\theta$

centre of the beam

$10\,Kg \times 9.8\,N/Kg \; 3.0m + 5kg\,(9.8\,N/Kg)(2\,m)$

$= F_T \; 4m \sin 40°$

$F_t = ((10x9.8x3)+(5x9.8x2))/(4xSin(40))=$
$152.4609350323204 = \boxed{1.5 \times 10^2 N}$

2. how do we get Fy and Fx?

$\sum F_{up} = \sum F_{down}$
$F_y + F_t \sin\theta = F_{g1} + F_{g2}$

$F_y + 152.46Sin(40) = 10x9.8+5x9.8$
$F_y = ((10x9.8)+(5x9.8)-152.46xSin(40))=$
$49.00060102719021 = \boxed{49N}$

You could also use torques but move the reference point to the other end.

$F_yL=F_{g1}\ L/2+ F_{g2}\ L/4$

you get the same answer

$F_x= F_t\cos\theta$ is the only sideways force

$F_x= 152.46\text{x}\cos(40)=$

$116.7911357979194 = 1.2\text{x}10^2\text{N}$

Q1-11 odds p 230

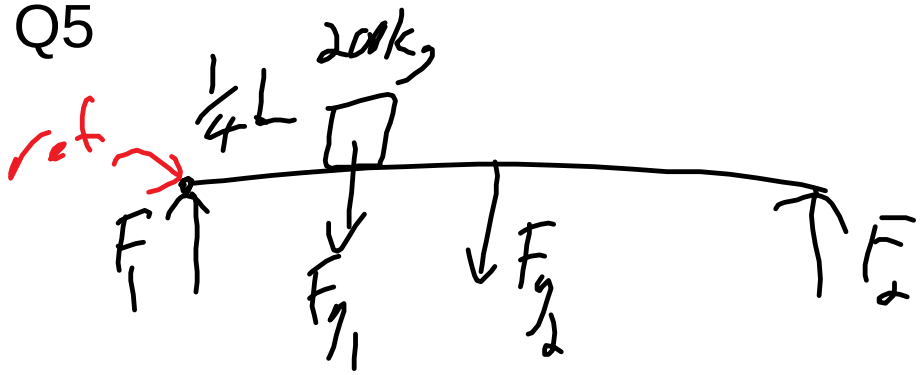
Q15, 17, 18 , 21, 61

bring lab-book next class

15 minutes

p230

Q5



$$\sum \tau_C = \sum \tau_{CC}$$

$$F_{g_1}\frac{1}{4}L + F_{g_2}\frac{1}{2}L = F_2 L$$

$$200\text{kg}\left(9.8\frac{\text{N}}{\text{kg}}\right)\frac{1}{4} + 160\text{kg}\left(9.8\frac{\text{N}}{\text{kg}}\right)\frac{1}{2} = F_2$$

F_2 = 200x9.8x0.25
+(180x9.8x0.5)=1,372.0

$F_2 = 1.4 \times 10^3 N$

$F_1+F_2 = F_{g1}+F_{g2}$
$F_1 = (200x9.8)+(180x9.8)-1,372.0=2,352.0$

$= 2.4x10^3 N$

$mv = Mv_2$
$v_2 = mv/M$

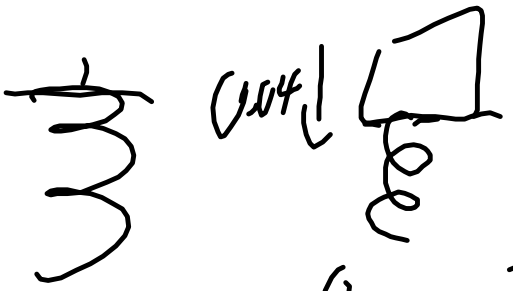
$$E_{g_i} = E_{g_f} + E_K + E_{lost}$$

$$-\frac{GMm}{(r_E + 400)} = -\frac{GMm}{(r_E + 100)} + \frac{1}{2}mv^2 + E_{lost}$$

(0.49)

$E_g \rightarrow E_{elastic}$

$\therefore 0.20m$



$$mg(h+x) = \frac{1}{2}kx^2$$

$$k = \frac{2mg(h+x)}{x^2}$$

$$k = \frac{2(0.75)(9.8)(0.200+0.040)}{(0.040)^2}$$

$$\simeq 2300 \ \frac{N}{m}$$

Q2 $P = 0.81 \times 9.3 \times 10^3 W$

$$= Fv$$

$$v = \frac{0.81 \times 9.3 \times 10^3 u}{0.35(450)(9.8)}$$